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Amateur Television Quarterly

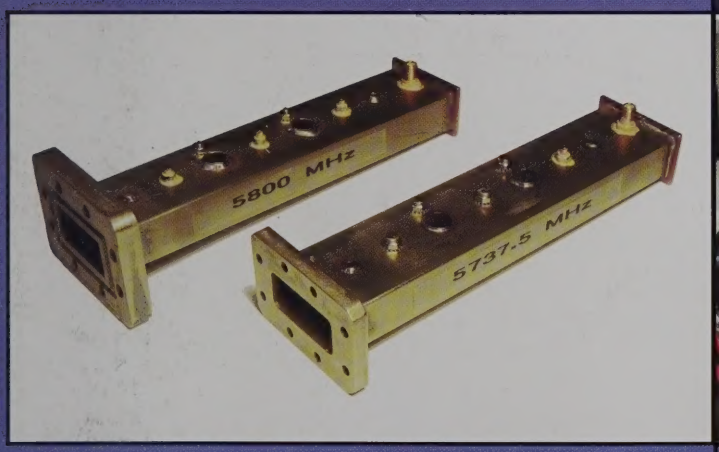
Waveguide Filter You Can Build

70 cm DATV Propagation Studies

Repeater Improvements and Beacons

ATV at Quartzite Ham Radio Day

ATV FM-VSB Experiments Part 2



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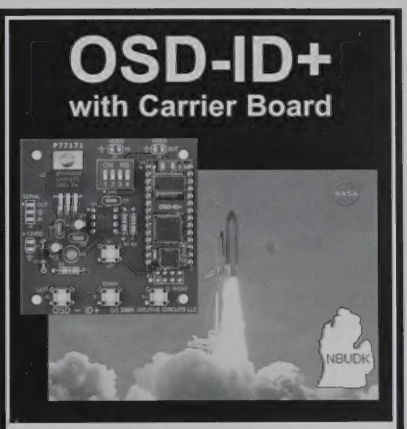

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Sync Buzz Editorial

Bill Brown WB8ELK & Mike Collis WA6SVT

ATV operation

ATV activity is increasing and several ATV repeaters have had improvements made, we feature some of them in this issue. The increase is not just digital but analog as well.

Dayton activities

Dave KC3AM has applied to DARA for the ATN booth "aka the ATV hangout" in the same space as last year. The ATV dinner will have to find a new restaurant, as Roush's is shutting down operation.

Art Towslee WA8RMC is looking for a new place for the Friday night ATV dinner. Art is also negotiating with DARA for the time and room for the Saturday ATV forum. The spring issue will have the Dayton ATV activities and a map to the new dinner location.

Articles needed

First we want to thank all of our authors for your sending in your article(s), however, we can use more. If you have any ATV news or technical ideas or projects you would like to share but not sure how to form it into an article we will be glad to help you.

Magazine layout

Over the last year, Bill has been busy at work and not much time for laying out the magazine. Mike has stepped up to the plate and done most of the layout for several issues. Please let us know how you like Mike's layout style and any suggestions are welcome.

Decade Engineering

We would like to thank Decade Engineering for advertizing over the years. They are reducing costs prior to retiring. KH6HTV Video (adjacent ad) h as increased his ad space into Decade prior spot. See Jim's new KH6HTV ad on page 25.

Stay tuned - Bill & Mike

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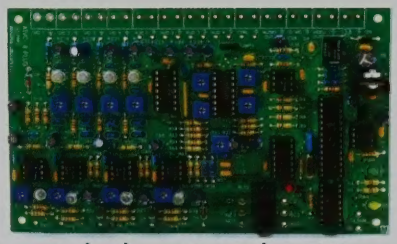

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70cm DATV Propagation Studies

-Jim Andrews KH6HTV

Propagation studies of the performance of the European Digital TV (DTV) broadcast standard, DVB-T, were performed by KH6HTV on the island of Maui, Hawaii. Tests were run on the amateur radio 70cm band. The general conclusions were that the path loss measured was typically 30dB worse than predicted by free space path loss. Excess path losses ranged from 15 to 46dB with a standard deviation (σ) of about 7dB for about 50 measurements.

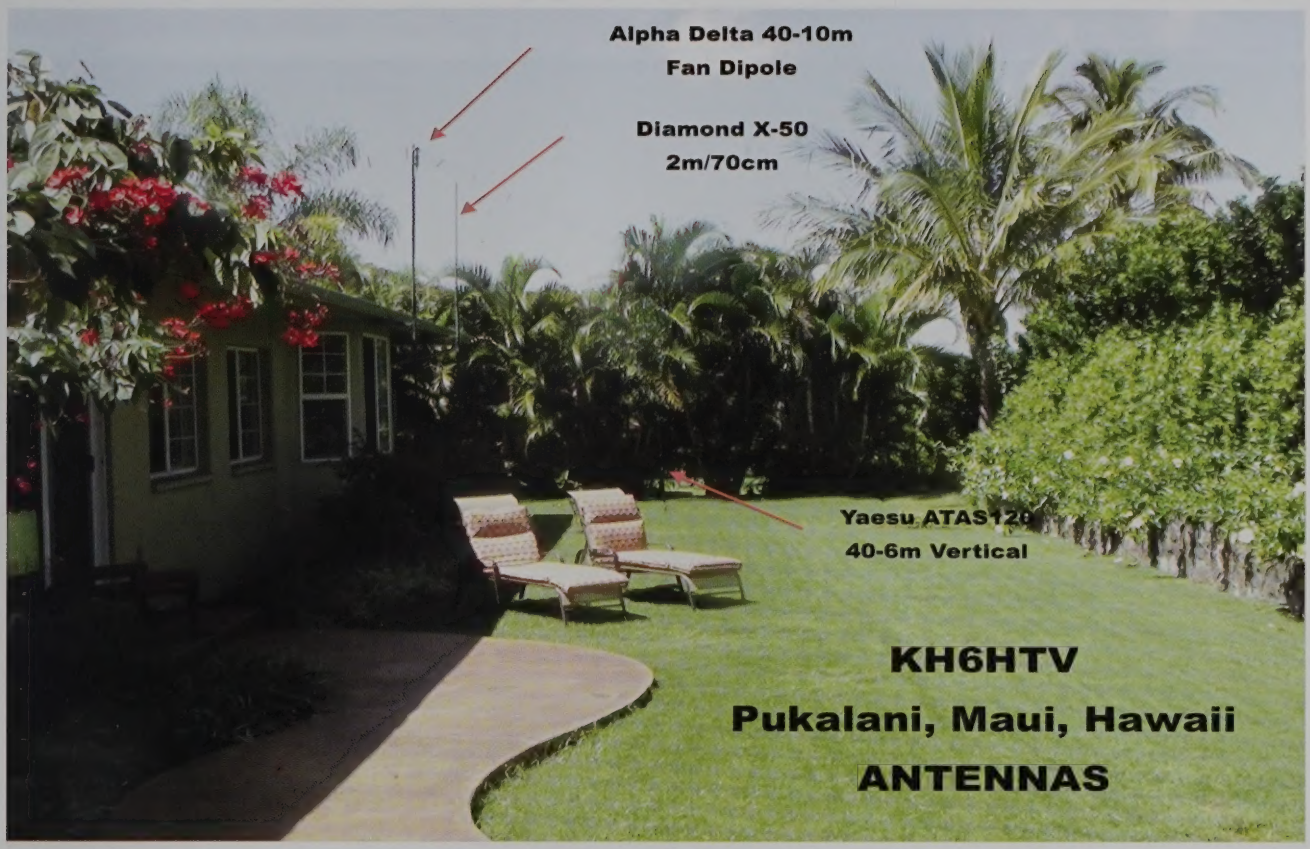
Measurement Details:

The DVB-T transmitter was a Hi-Des model HV-100EH Modulator driving a KH6HTV Video, model 70-9A Amplifier. The output power was almost 10 Watts avg. (+39.3dBm). The modulator parameters were set as follows: 429 MHz center frequency (Ch 58), 6 MHz bandwidth, QPSK, H.264 video encoding, 8K FFT, 5/6 FEC, 1/16 Guard Interval.

The video source was a Canon camcorder running a pre-recorded video and audio program to provide "live" video. The camcorder output was 1080P, but it was passed through an HDMI/composite converter to provide a 480i composite video signal to the transmitter.. (*Note: This was done to allow the use of the on-screen-display (OSD) of received signal strength and s/n. The Hi-Des receiver's OSD doesn't work well with 1080P.*).

The 70cm transmit antenna was a Diamond model X-50 (+10.9dBi). Transmit coax was 50ft, of 9913/N (-1.4dB). Antenna height was approximately 4 1/4 meters. It should be noted that the antenna was not high enough to clear all surrounding trees, vegetation and buildings. Thus extra path loss attenuation due to absorption from vegetation, etc. in the near vicinity of the transmitter is to be expected.

The transmitter location was at KH6HTV's QTH located in Pukalani, Maui, Hawaii. (20^{O} 49'36"N x 156^{O} 19' 50"W) This is on the slopes of Mt. Haleakala, a 10,000 ft. volcano. The transmitter was at an elevation of approx. 1,200 ft above sea level. Unobstructed views from this location are only to the south-east up the slopes of Mt. Haleakala and to the south-west towards the west Maui mountains. The Haleakala highway and the observatories at the summit of Mt. Haleakala are visible from KH6HTV. The view north down into the central Maui valley is obstructed by nearby houses and trees.

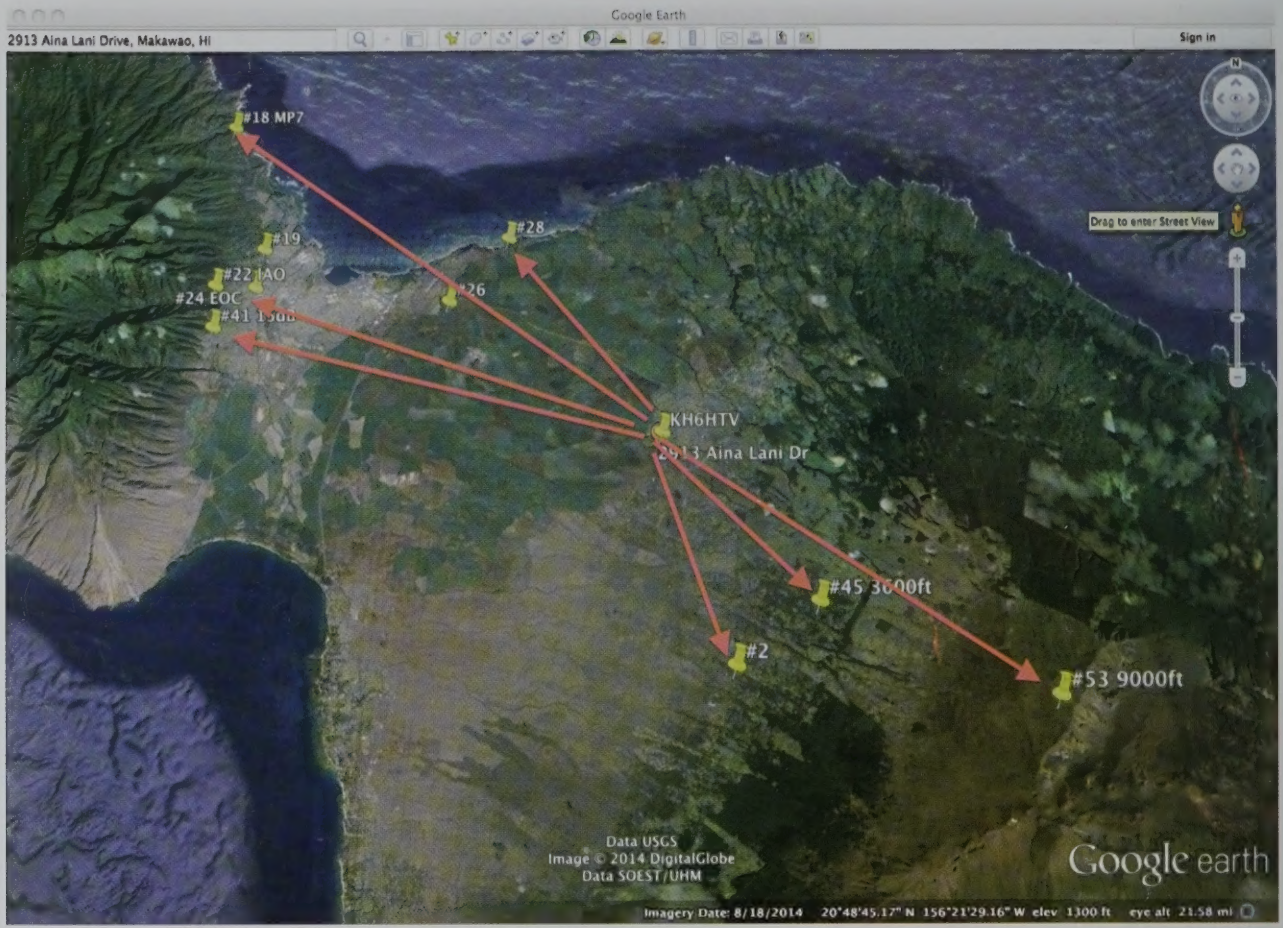


The DTV receiver was in an automobile which was driven around the island of Maui, both in the central valley and on Mt. Haelakala. The receive antenna was a Larsen 5/8λ mobile whip antenna (+8.1dBi) on a Larsen mag. mount base with 15 ft of RG-58coax (-1.6dB). The automobile was a Mazda Miata convertible. The antenna was mounted on the center of the windshield frame at an approximate height of 1.2 meters. The DVB-T receiver was a Hi-Des model HV-110. An ARR model P432PDG pre-amplifier (20dB gain, 0.8dB NF) was used in front of the receiver.

The DTV digital threshold sensitivity of the pre-amp/rcvr. combo was -100dBm. The composite (480i) video (plus audio) output from the receiver was displayed on a Haier, 12Vdc, 7" color video monitor. The OSD was activated on the receiver to display both the received signal strength in dBm and the signal to noise ratio in dB. These values were recorded at each location. The Receive Power (P_{rcv}) recorded was corrected by subtracting the 20dB gain of the pre-amp from the observed OSD value.

The receiving automobile was driven around the immediate neighborhood of Pukalani to measure strong, local signals. It was then driven down the Haleakala highway to the main towns of Kahalui and Wailuku. Signals were very marginal along the highway until arriving near the airport. Signals were intermittently received at various locations in both Kahalui and Wailuku and as far west as Wailuku Heights and as far east as Spreckelsville. The automobile was also driven "up-country" along both the Kula highway and also the Haleakala highway all the way to the 10,000 ft. summit.

The video monitor gave both an audio and video display of the received signal while the automobile was in motion. DVB-T does work well in a mobile environment with doppler shift. Measurements of received signal strength (in dBm) and signal to noise ratio (in dB) were made at a total of 53 locations. These measurements where only done where a picture was being received and it was also safe to pull over to the side of the road to make the measurements.



At each location an i-phone GPS receiver was used to determine the latitude and longitude of each site. Distances and elevations were then determined using Goggle Earth. The aerial view shown above shows the location of a few of these sites. They are seen to be predominantly on either a north-west or south-east bearing from the Pukalani transmitter site.

The DTV transmitter's output power, P_{xmit}(dBm), was measured in true RMS using an HP-232A Power Meter with a model 8478B thermistor power sensor head. A Narda model 776-B, 30dB, 50 Watt attenuator was used in front of the power sensor. The gains for the transmit and receive antennas were previously measured and reported in KH6HTV Video application note, AN-4 (available at www.kh6htv.com). In lab bench tests, the Hi-Des HV-110 receiver's OSD power meter was found to be quite accurate (< ±1dB) from -10dBm to -90dBm.

Path Loss Calculations:

The Free Space Path Loss, PL_{fs}, in dB was calculated using the equation:

$$PL_{fs}(dB) = 20*\log(\text{freq in MHz}) + 20*\log(\text{distance in miles}) + 36.6dB$$

$$PL_{fs}(dB\ @429MHz) = 89.2dB + 20*\log(\text{distance in miles})$$

The predicted power at the receiver (in dBm) is calculated from the equation:

$$P_{rcv}(dBm) = P_{xmit}(dBm) - \text{Xmit Cable Loss (dB)} + \text{Xmit Antenna Gain (dBi)} - \text{Path Loss (dB)} + \text{Rcv Antenna Gain (dBi)} - \text{Rcv Cable Loss (dB)}$$

Inserting the above values:

P_{rcv}(dBm) = +39.3dBm -1.4dB +10.9dBi - PL(dB) +8.1dBi -1.6dB

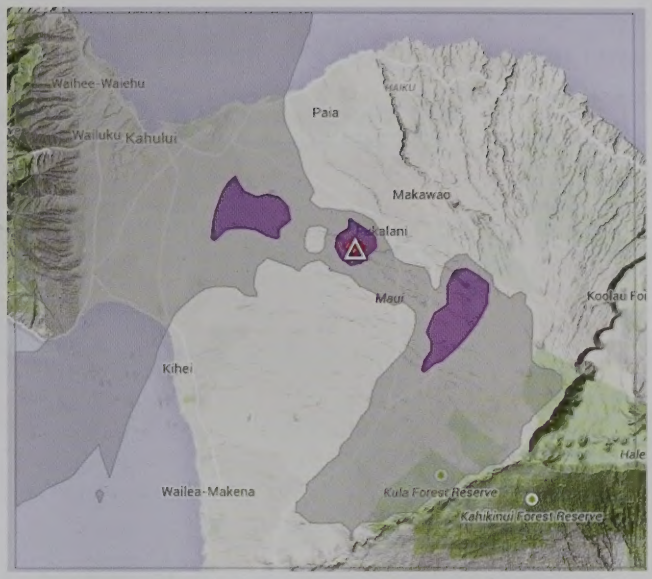
or Path Loss (dB) = 55.3dBm - P_{rcv}(dBm)

For example at the farthest distance of 14.4 miles (location #18), the recorded receive power was -59dBm with a s/n = 19dB. Removing the 20dB pre-amp gain says the signal strength from the antenna was -79dBm. Thus the actual path loss was -134dB. The theoretical free space path loss, PL_{fs}, for 14.4 miles would be -112dB. Thus the excess path loss was -22dB.

Propagation Conclusions: Actual, measured Path Loss varied from 15dB to 46dB worse than theoretical free space path loss. Data where no picture was received was thrown out. There were 47 valid observations made. The mean value was 29.8dB. The standard deviation (σ) was 6.8dB. Best cases were in the range of 15-25dB where both the transmitting and receiving sites were higher than the intermediate terrain, with essentially "line-of-sight" paths.

Longley-Rice Predicted RF Coverage Map:
Phil Rice and A.G. Longley performed a lot of VHF/UHF propagation research at NBS-Boulder in the 1960s. They developed a computer program to predict RF coverage maps. This program is now available as a free, valuable, on-line computing tool from the Communications Research Centre - Canada
(http://lrcov.crc.ca/main)

Using the Longley-Rice program, RF coverage maps were generated for the specific parameters of this 70cm, DVB-T propagation test. When they were adjusted by adding an additional 30dB of path loss, and using a 95% confidence, their predictions matched well with the results of the actual field survey.



Longley-Rice RF Prediction Map -- added 30dB to contours to match field data -- Gray = 54-64 dBuV/m, Blue = 64-74 dBuV/m, Red = >74 dBuV/m --- 95% confidence --- transmit antenna at 4 m & receive antenna at 1.5 m

The complete tabulated field measurement data and detailed calculations for data entry to the Longley-Rice program are available, upon request, from KH6HTV Video in a much longer paper.

Aloha,
Jim KH6HTV

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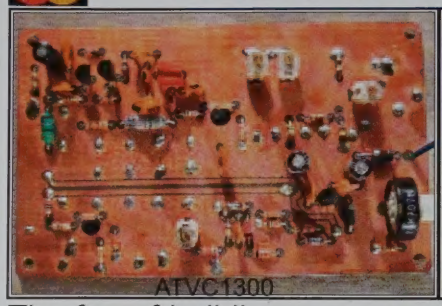
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HV-120 is a 1080p wide band DVB-T Ham TV receiver box . Outputs are HDMI & CVBS. Frequency range is 100-950 MHz & 1150-2650 MHz. 2-8 MHz bandwidths supported.

Waveguide Filter Construction

-Steve J. Noll, WA6EJO

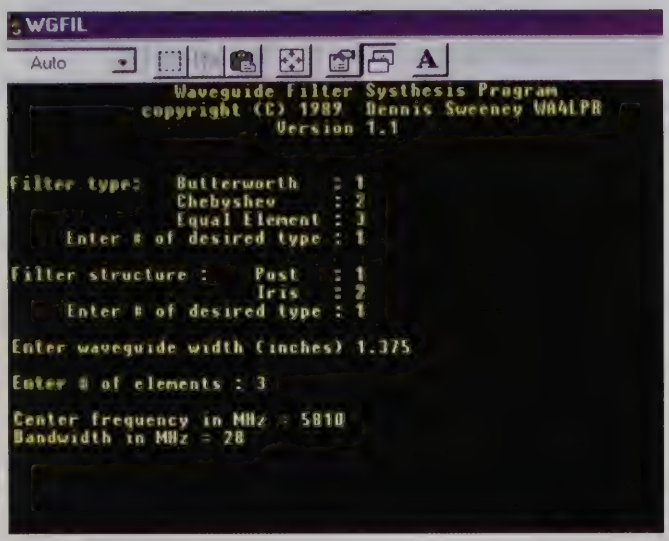
This article describes construction of waveguide bandpass filters for the 5 cm band. These filters were built for use by the Amateur Television Network, primarily for the Southern California section of the network. The filter designs are by others, specifically Paul Wade, W1GHZ, in his QEX magazine series, "Waveguide Filters You Can Build *and* Tune" and Dennis Sweeney's, WA4LPR, "WGFIL" software program. Both the articles and the software are available online.

Four filters were built, one of the post type for 5737.5 MHz, another post type for 5800 MHz, and two of the evanescent type for 5910 MHz. These filters where build for the W6ATN 5 GHz microwave link project that the Amateur TV Network built at Ord Mountain to Jobs Peak. At the Ord Mountain site, three 5 GHz requencies are used. RX 5737.5 MHz, and 5910 MHz TX FM analog duplexed on the vertical polarized dish waveguide and 5800 MHz digital spread spectrum TX/RX (TDM) on the horizontal polarized waveguide. At the Jobs Peak end a separate Vertical polarized 5737.5 MHz TX dish is used and another dual polarized dish for 5910 MHz RX using the evanescent mode 5910 filter on the vertical polarized port and 5800 MHz TX/RX digital spread spectrum radio on the horizontal port.

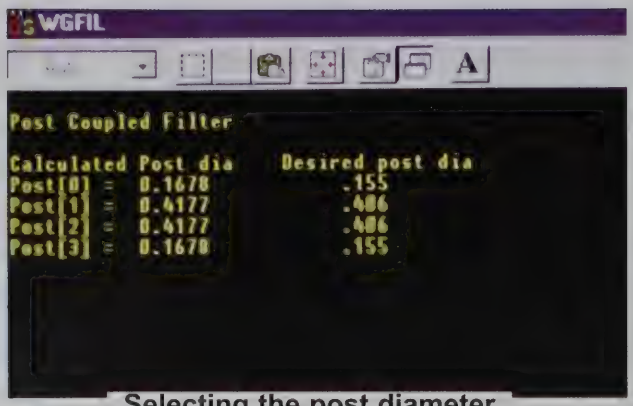
Design Software:

The post filters were built in brass WR-137 waveguide that normally supports 5.85 to 8.20 GHz. This filter design is described in Wade's article[1] with the actual dimensions calculated by using Sweeney's software[2,3]. Note that the software, while quite easy to use, is MS DOS based so may not install on a newer computer. I had no luck on my Windows 7 computer but no problems installing and running the program on an old Windows 98 machine.

The WGFIL program asks for the filter type (Butterworth, Chebyshev, or Equal Element,) filter structure (Post or Iris,) the waveguide width in inches, the number of elements (i.e., cavities, where 3 cavities would require four posts,) and finally the frequency and bandwidth in MHz. Unfortunately the program does not report the expected insertion loss.

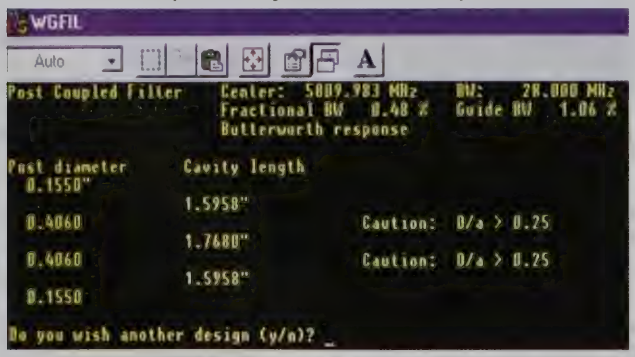

WGFIL
Auto
Waveguide Filter Systhesis Program
copyright (C) 1989 Dennis Sweeney WA4LPR
Version 1.1
Filter type: Butterworth : 1
Chebyshev : 2
Equal Element : 3
Enter # of desired type : 1
Filter structure : Post : 1
Iris : 2
Enter # of desired type : 1
Enter waveguide width (inches) 1.375
Enter # of elements : 3
Center frequency in MHz = 5810
Bandwidth in MHz = 28

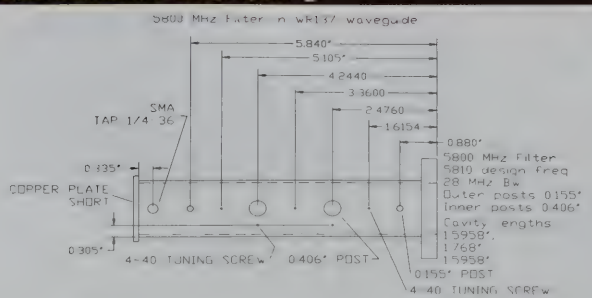
The program then gives you the needed post diameters, but you can enter your own if you don't want to custom machine its post diameter suggestions. Presumably, the filter will work acceptably if you don't stray too far from its suggestions. The program will calculate the post positions using the post diameters that you select. A good choice for the posts are brass tubes made by K&S Precision Metals, available from hobby shops or McMaster-Carr. This tubing solders easily and is available in 1/32-inch (0.03125") increments from 1/16" OD to 21/32" OD. Many match common fractional drill bit diameters. This tubing is best cut with a razor saw such as is available from Xacto or McMaster-Carr. For the 5737.5 MHz and 5800 MHz post filters I chose 5/32-inch and 13/32-inch tubing as those match standard drill bit sizes and are within a few percent of the program's suggested diameters.



Selecting the post diameter

In the final screen the WGFIL program gives you the cavity lengths, that is, the distance between the centers of the posts. One should consider designing the filter for a few MHz high in frequency as it is possible to tune the filter lower than the frequency it ends up at after fabrication. It may not be possible to raise the frequency if it ends up too low. I did not allow for this on the first filter I made, the 5737.5 MHz filter, and it turned out a tiny bit low in frequency, but still acceptable. The 5800 MHz filter actually was made with the dimensions of a 5810 MHz filter so that it could be tuned down to 5800 if needed, which it did. Tuning can be accomplished by adding small tuning screws (i.e., 4-40 or 6-32,) midway between the posts.





Fabrication:

The holes for the posts are drilled through both walls of the waveguide. When the posts are installed they are soldered in place. I used a paint stripper heat gun for soldering the posts, and a hotplate for soldering the SMA-end short. The SMA sparkplug-type connectors were simply threaded in and locked in place with a lock washer and nut.

Soldering on the waveguide short.

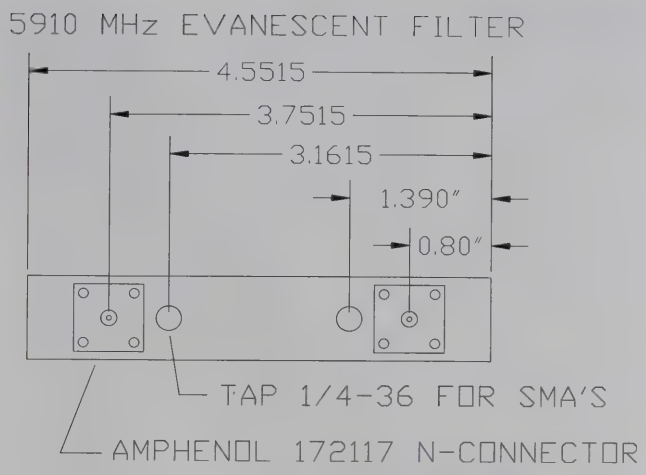
The filter is held securely during soldering using a drill press as a vise with a piece of Teflon insulating the drill chuck.

In the case of these post filters, coax cable connections were desired at one end, waveguide flanges at the other end. The surplus piece of waveguide used already had flanges on each end and was long enough to make two filters so it was cut in two leaving the cut ends needing coax connectors. Another Paul Wade article comes to the rescue for the coax connection design: "Rectangular Waveguide to Coax Transition Design" in Nov/Dec 2006 QEX has a table with the needed dimensions[4]. Approximately 0.8-inch separation was made between the coax connector probe and the nearest filter post. This distance was a somewhat arbitrary selection.

Completed waveguide post filters

The evanescent-mode filter is an odd bird. The waveguide it is built with is much smaller that would be required to conduct the filter's frequency. The 5910 MHz evanescent filters are built using WR-75 waveguide which is designed for 10 to 15 GHz. Construction is somewhat simpler than the post filter. Unfortunately the WGFIL design program does not cover this kind of filter. The dimensions were taken from Table 1 for 5760 MHz filters in Wade's article section, "Evanescent Mode Waveguide Filters." This type of filter calls for two tuning screws (no posts) and coax connectors whose center pins go clear through the waveguide.

The 5760 MHz design calls for ¼-28 tuning screws. Having a ¼-28 tap but no screws, I opted to use SMA connectors as the tuning screws becauses I had the requisite ¼-36 tap. This provided a bit finer adjustment and gold plating to boot. The contacts were pulled from the SMAs leaving the Teflon insulator in place. Filling the cavity between the end of the Teflon and the opening of the connector with solder reduced the insertion loss by 0.7 dB, and soldering in a slug of copper reduced the insertion loss further to 0.7 dB. These filters can be operated with the waveguide ends open. Poking anything in the opening a small distance has no effect on the filter, but I would recommend sealing the ends off to prevent insect entry. Any foreign object within the active part of the filter will have a deleterious effect.

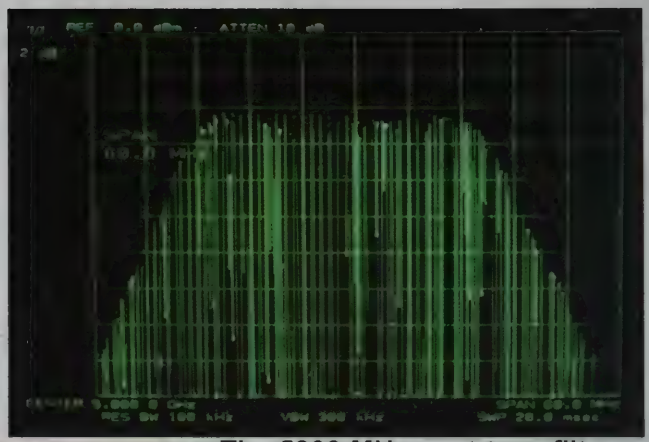


Completed Evanescent Mode Filter side and end view

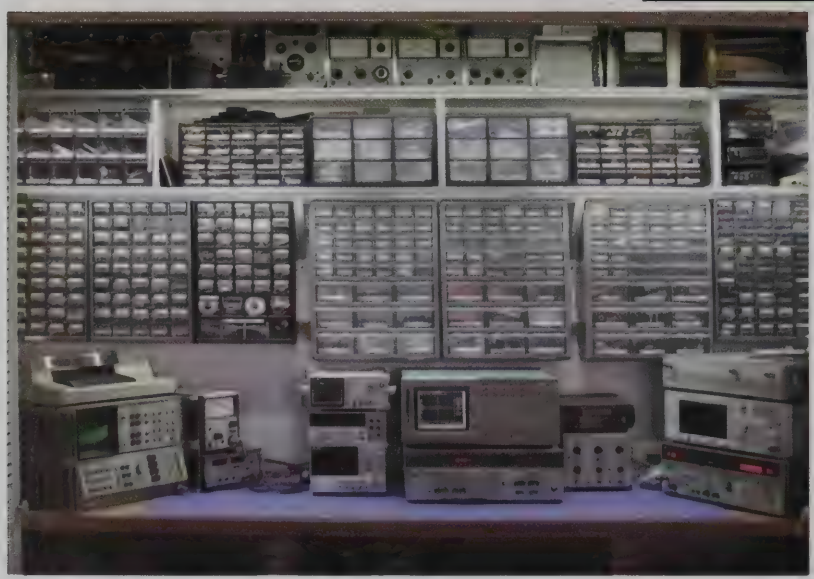
Tuning screws made from SMA connectors.

Tuning the filters:

Some test equipment is needed for tune-up. A network analyzer would be nice, or a spectrum analyzer with a tracking generator. I have neither, but do have a HP 8673B signal generator that covers 2 GHz to 26 GHz, and a HP 8566B spectrum analyzer that goes to 22 GHz. Those, plus a HP 432A power meter are more than adequate for tune-up. One could do a pretty good job with just a signal generator and a power meter and a bit more time.



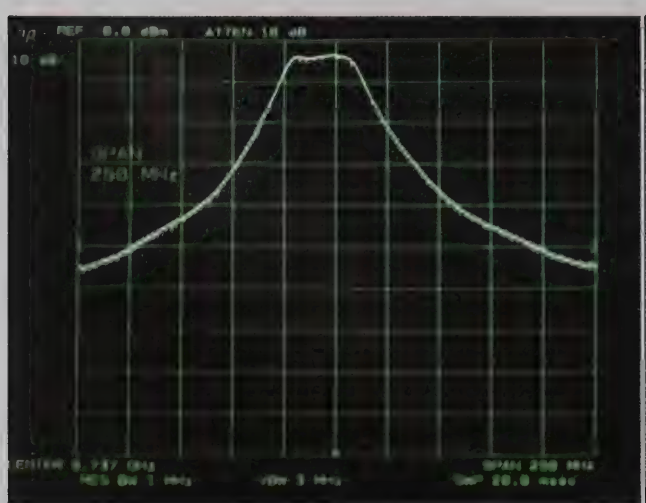
The 5800 MHz post-type filter came out much closer to frequency, and quite flat (note the 2 dB/cm scale.) Insertion loss is a pleasing 0.7 dB.



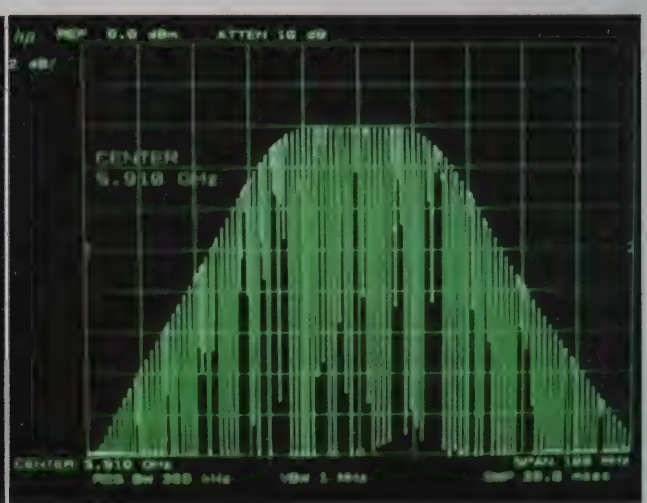
Test lab in a closet.

The 5800 and 5910 images were generated by sweeping the signal generator across the selected spectrum analyzer's bandwidth with the max hold function turned on to show the filter's response.

The lower left image took me a long time to fully fill in the response.



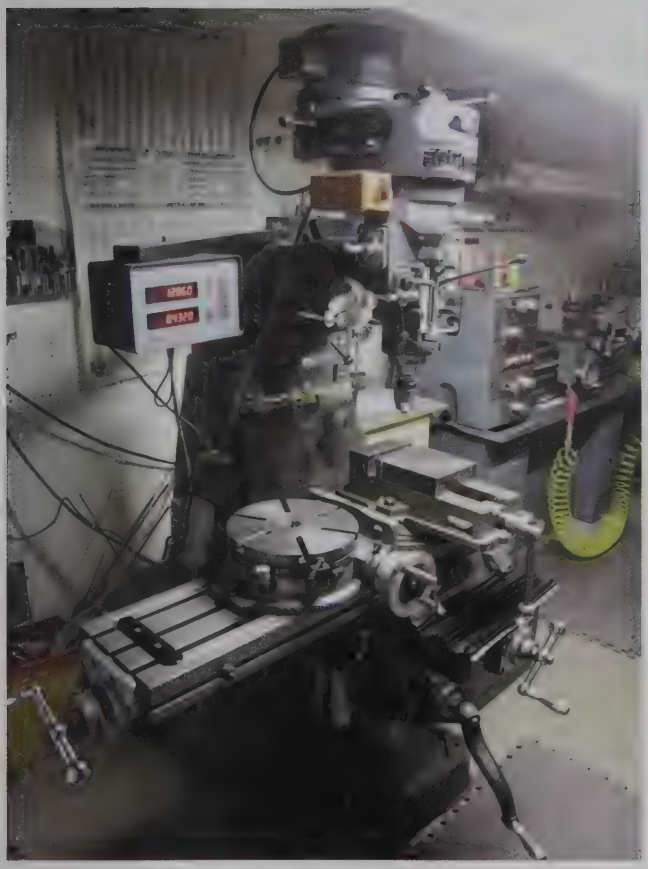
The 5737.5 MHz came out a bit low in frequency with 1.1 dB insertion loss.



The 5910 MHz evanescent filter tuned up dead-on. Insertion loss is 0.7 dB.

Conclusion:

As one may imagine a high degree of accuracy is desired for fabricating microwave filters. Nothing beats having access to a milling machine. Even if you never 'mill' anything with it, it makes for an incredible drill press. Accuracy and repeatability to within one or two mils (thousandth of an inch) is no problem. Cost is the same as a high-end Ham transceiver.



My Milling machine

Some machining techniques will help improve accuracy even if you only have a drill press. Start every hole with a drill-point countersink.

They are extremely stiff and won't wander around when starting a hole. When tapping holes use a tap guide to keep the tap straight. This will also greatly reduce tap breakage.

Above, Drill-point countersink bit

Left, Spring-loaded tap guide

References:

1) www.w1ghz.org/filter/Waveguide_Filters_You_Can_build.pdf

2) www.w1ghz.org/filter/WGFIL.COM

3) www.pamicrowaves.nl/website/technica_articles/WGFIL.PDF (Instructions for WGFIL)

4) www.w1ghz.org/QEX/Rectangular_Waveguide_to_Coax_Transition_Design.pdf

73, Steve WA6EJO

2016 ATN-AZ Winter Meeting

- Lee Weitzel K0CCU

The Arizona Chapter of Amateur Television Network's 2016 Winter Meeting is now as they say "In the books". By the looks of the spread that Kevin AD7OI and his wife Tammy (studying for her ticket) made, everyone had a good time and no one went away hungry that's for sure. The desserts were GREAT. **Below Tammy Jacobson**

Most of our members attended and Kevin AD7OI invited the VHF-UHF and 10 GHz microwave group to join us. This combined group more than doubted the size that usually attend the meeting. We made many new friends, some of the microwave group were past ATVers and we now have a couple of them coming back to ATV! The ATVers interest peaked when hearing about weak signal and microwave activities.

The entire group enjoyed hearing about DATV experimenting results from the report Jim KB7YSY and Peter KD7OIW presented. Kevin AD7OI has put together a 10 GHz CW beacon. He demoded it to the group along with his 10 GHz portable contest gear. He had the beacon down for upgrades before re-installing it on White Tank Mountain.

Now that lunch and above presentations were finished, our president Peter KD7OIW called the meeting to order. We had introductions with the opportunity for each person to talk about their ATV or microwave activities. We had hams from as far as New Mexico and California attend!

Bob W8ARZ, our treasure, gave the financial report and ATV net activity. Our trustee, Kevin AD7OI, gave a report covering White Tank and Mt. Lemmon repeaters. Jerry N7QVU gave a report on Green's Peak.

Mike WA6SVT gave a report about ATN in California's repeaters and discussed the future link between Arizona and California including the dish install at Snow Peak in California aimed at Hayden in Arizona where he and Kevin made a link feasibility trip to last August (Fall issue of ATVQ pages 9-11).

We then held nominations followed by election of club officers for 2016. Peter KD7OIW was re-elected as President , Rod WB9KMO was elected as Vice President and Lee K0CCU was re-elected as Promotions for another year. Special thanks to Kevin AD7OI as for filling the Vice Presidents post for a number of years even with his very hectic schedule. Thanks again Kevin.

Rod Fritz our new Vice President

The business part of the meeting was adjourned and the group walked over to Kevin's bench area where a very informative demonstration on FM-Vestigial ATV was presented by Mike WA6SVT.

This is the new analog ATV format that Grant Taylor ZL1WTT presented in the last issue of ATVQ. Grant ZL1WTT had visited Mike WA6SVT on his relocating from New Zealand to Canada and left his FM VSB gear for demos. Grant is now ZL1WTT/VE3. I'm sure there will be some great "Eye Ball" contacts this year at Dayton Hamvention.

Our President Peter KD7OIW

More of the group that attended the meeting

The club received an equipment donation from Chris N7TWW of two relay racks full of 12 GHz receivers and transmitters. Thank you Chris for your donation! Peter KD7OIW is already converting them to 10 GHz.

Again thank you Kevin AD7OI and Tammy for the use of your facility and the great food again this year.

Also our thank to Mike WA6SVT for coming to the meeting and bringing Rodger W6HMW. It's nice to see Rodger in person instead of on the BATC.

Log into the BATC's Streaming Video website and see us on our two weekly nets; Sunday and Wednesday evening at 7 PM mountain standard time.

73, Lee K0CCU

ATV FM VSB experiments, part 2: North American 6 MHz B/W on 70 cm

- Grant Taylor ZL1WTT & Mike Collis WA6SVT

In the fall 2015 issue, Grant introduced us to FM VSB occupying an 8 MHz wide 70cm channel with PAL analog video. He wanted to see if it was possible to make it work with NTSC and North American 6 MHz wide 70 cm channels but time was running out as he was relocating to Canada.

I invited Grant to stop by for a few days at my QTH as he was changing planes in Los Angeles and he arranged his flights to allow the visit.

About two weeks prior to his departure he mailed me his collection of boards and projects as it would be several months before he would have a larger place to set up his lab in Canada. I picked him up Saturday January 2nd at LAX airport and off to the KCBS TV Studios for a tour then we had lunch before arriving at my QTH. Most would want to get some rest after an all night flight and full filled day touring a large TV studio. Not Grant, after a shower he was ready to play ATV! We unpacked his project box and talked about how his FM- VSB boards would work using NTSC. We fired it up and they worked fine, but it still occupied nearly 8 MHz bandwidth.

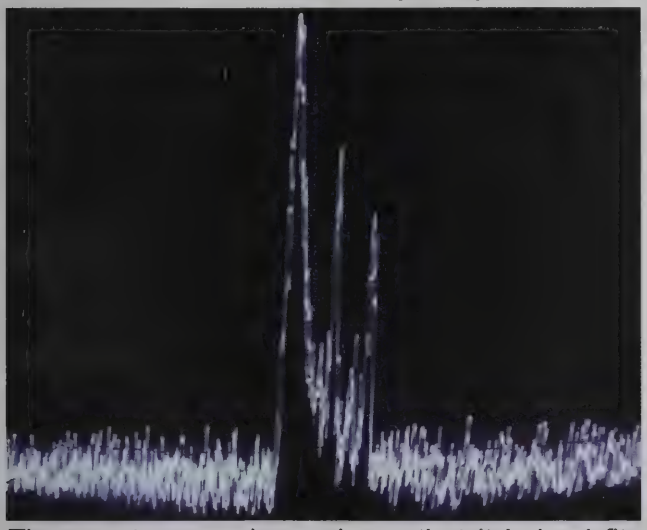
The next day we brainstorming and I remembered the old days of putting narrow (3 MHz deviation) FM in 10 MHz wide business microwave channels FCC part 101. We had to use a single 4.5 MHz audio subcarrier. I have a drawer full of 4.5 MHz ceramic filters so we could make the change.

The conversion

On the exciter, we removed the original 5.742 MHz ceramic subcarrier filter and soldered in a 4.5 MHz filter then retuned the oscillator for 4.5 MHz. We did the same change to the receiver to move it to 4.5 MHz. The 2nd subcarrier was turned off in the exciter. The sound subcarrier trap in the receiver was tuned to notch out the 4.5 subcarrier from the video.

The results

It fits into a 6 MHz channel! It performs about the same as it did before on a 8 MHz channel using PAL video. **Below is the occupied spectrum**



The spectrum analyzer shows that it indeed fits within 6 MHz and has a spectrum that is very close to that of AM VSB. Frequency and deviation adjustment is a bit critical.

Amplifying FM VSB is different than normal FM. Usually FM can be amplified using a class "C" amplifier, not so with FM VSB, a linear amplifier is needed to preserve the VSB filtering.

I have been asked how does it look? Is this real or a joke? What is the sensitivity for snow free as compared to AM or AM VSB? Lots of good questions, now for the answers. Using the same LNA and 434 MHz the following was measured at my lab.

AM VSB requires -61 dBm for 42 db video S/N ratio. 6 MHz noise floor is -103 dBm with a 2 dB noise figure receiver.

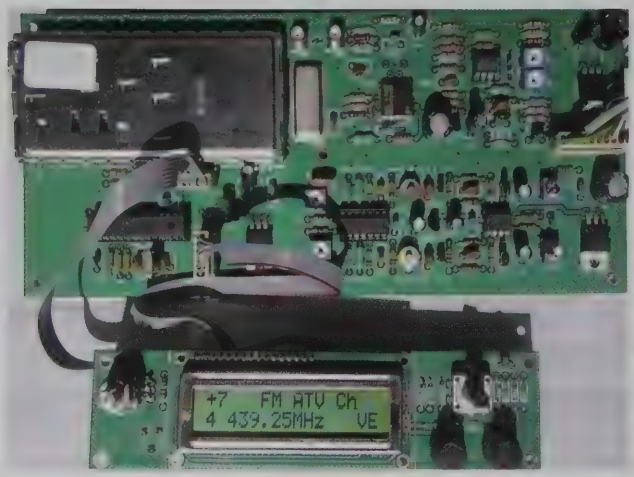
FM VSB at -76 dBm level gives you a 42 dB S/N ratio. That's 15 db better! The large FM sparkles go away at -84 dBm but the video has a fine grain (noise) to it and looks like P4 AM. Because the modulation index is low as compared to 4 MHz deviation normal FM it takes about 8 db more RF to fully quiet the receiver. Normal FM needs only a few db above the point the sparkles are gone.

You can say FM VSB has some properties of AM and FM. Another advantage to FM is capture affect and FM VSB is good at covering up noise about 10 to 12 db or lower QRM. AM can show QRM with the undesired signal down 40 dB although it is light. Bring that QRM up to -15 or 20 db below and the picture is not worth watching.

The Picture above is FM VSB at -84 dBM

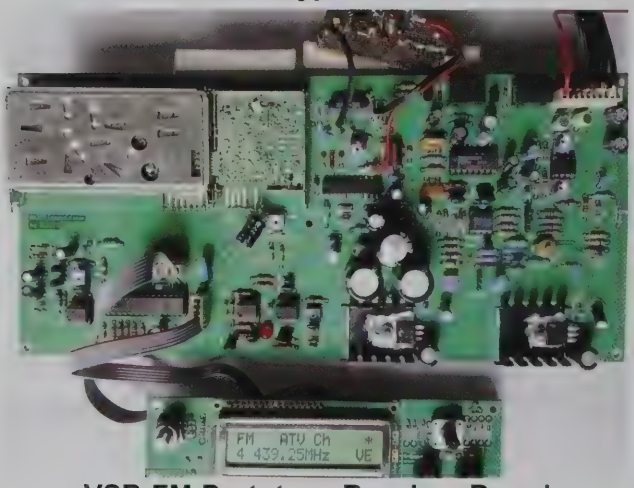
The picture above is FM VSB at -76 dBM

Not bad at all for a lower signal level than AM or AM VSB. Does this work mobile? Yes it does and is simular to AM but not as much amplitude fluctuations to the video in motion most likely due to the limiter circuit in the receiver.



VSB-FM Prototype Exciter Board

Grant showing the receiver board in a chassis

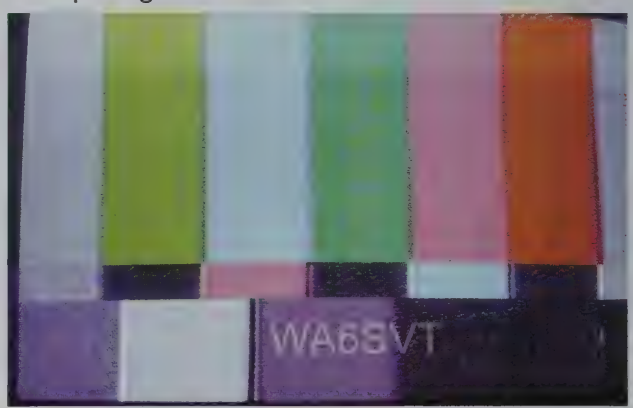


VSB-FM Prototype Receiver Board

Many years ago I asked can you VSB filter AM and was told no you cannot. Well Grant has done it, I have seen it in my lab and shown it to several ATVers. It is not perfect but it works well. The secret to making it work is two primary obstacles have to be resolved. Locking the video carrier to the blanking and correcting the group delay of the filter so the chroma phase is not shifted.

As Grant mentioned in part 1 using a 70 MHz VSB filter with built in group delay correction takes care of the shift but how to lock to the video blanking? A DC coupled video circuit and VCO is needed and free running, not locked to a PLL. Because the IF is 70 MHz, drift is not a problem.
The video input is AC coupled but a DC restoration circuit locks onto the video blanking.

Grant's ATV equipment control board is used with both the exciter and receiver boards to set frequency power and other system settings. There is enough memory to include the channel plan for several ATV channels for several countries. In the photo to the left is VE channel plan (Canada). I took the receiver mobile and took the photo below after pulling over to the side of the road.



Received Mobile picture at side of road.

Mobile operation is fair to good but multipath is more noticeable that in AM or regular FM probably due to the low modulation index used.

73, Grant ZL1WTT/VE3
& Mike WA6SVT

Digital ATV and High Definition Digital ATV in TV Technology Magazine

-ATVQ

TV Technology is a broadcast television magazine for engineers, technicians and others that like to stay on top of the latest television developments and trends.

Late last year James O'Neal K4XAR, technical advisor to TV Technology, contacted Jim Andrews KH6HTV, Art Towslee WA8RMC and Mike Collis WA6SVT to ask if he could interview us about digital ATV for a two part article in TV Technology. We were honored to be interviewed by James and we shared where ATV is now and the digital revolution transforming our mode.

Part 1 in the December issue featured Art Towslee WA8RMC and the first DATV added to a repeater using the DVB-S mode. Part 2 in the January issue featured Mike Collis WA6SVT talking about QAM-64 and DVB-T High Definition and DATV in different parts of the country. Jim Andrews KH6HTV also discussed High Definition ATV and it's use in public service.

http://www.tvtechnology.com/broadcast-engineering/0029/ham-tv-operators-go-high-definition/277772

Ham TV Operators Go High Definition

Experiments with QAM and DVB codingJanuary 21, 2016

By James O'Neal

James O'Neal is the technical advisor to TV Technology. ***(note: James' call sign is K4XAR)***

ALEXANDRIA, VA.—As described in the initial installment of this article on the movement by radio amateurs or "hams" to digital video transmission, hams have been experimenting with television since the 1920s, and as a group are acutely aware of technological developments in this area, as many are employed in the TV broadcasting, R&D and manufacturing sectors. Through the years, hams have always been quick to try out new technologies including microwave, satellite, digital communications, and most recently, high-definition television.

Mike Collis, WA6SVT

Mike Collis is one of those HD adopters. He's a California ham (station call sign WA6SVT) who's been involved in amateur TV since 1976 during his high school days, and recently ventured into high definition. (He's also transmitter supervisor at a commercial television operation.) "I moved into high definition about two years ago," Collis said. "The incentive was the higher clarity pictures."

Collis is in a fairly unique position in terms of keeping track of the segment of the amateur operators involved in television, as he's co-publisher of *Amateur Television Quarterly*, a niche publication dedicated to news of amateur TV experimentation that's read by more than 400 hams. It was a report of HDTV experimentation by a fellow ham that led Collis to make the shift to high definition.

"I was inspired by Jim Andrews who was doing HD with a Drake 64-QAM cable TV modulator," Collis said. "I purchased a Drake unit [and went on-the-air with this]."

Amateur Radio Operators Convert to Digital Television – Part 1

By James O'Neal

Some now on-the-air in high definition. December 21, 2015
http://www.tvtechnology.com/broadcast-engineering/0029/amateur-radio-operators-convert-to-digital-television--part-1/277663

ALEXANDRIA, VA.—Radio amateurs, or "hams," have been involved in one way or another with television practically ever since commercial entities began developmental work in the medium during the 1920s. And many TV engineers have held ham licenses and performed their own share of experimental work in their off-duty hours. Early on, at least one manufacturer offered camera pickup tubes at discounted prices to encourage experimentation by the radio amateur community.

Ham TV has evolved right along with the rest of the industry, moving from mechanical scanning to all-electronic operation, then color, and eventually to digital video and most recently, high-definition imaging. And while commercial television entities have routinely spent hundreds of thousands of dollars in retrofitting analog plants for digital broadcasting, hams—being an ingenious and creative lot—have managed to go digital on the cheap.

Art Towslee (amateur station call sign WA8RMC) is one of these DTV pioneers. He's now 74 and a retired Ohio electrical engineer who once specialized in the design of industrial weighing equipment. His interest in both ham radio and television date back to the mid-1960s.

Art Towslee

"A bunch of guys I knew were playing with some war surplus UHF radio gear and actually using it to transmit video," said Towslee. "I became very interested and got my ham license in 1965."

For the past 50 years, Towslee has continued to experiment with television transmission in the amateur radio spectrum—they are assigned chunks of RF real estate in the UHF and higher frequency bands for such work—and a few years ago, along with other members of his Columbus-area amateur radio club, transitioned to digital video, becoming the first such group in

Collis can't say for sure how many of his readers are testing the high-definition waters, but is aware of amateur HDTV activity in various parts of the United States, including both northern and southern California, Ohio, Kentucky and Arizona.

One of the most active of these is the aforementioned Jim Andrews (station call sign KH6HTV). He's a retired electrical engineer and spends his time just about equally in Maui, Hawaii and Boulder, Colo. His experimentation with analog television on the ham bands (amateurs are allocated several chunks of RF spectrum real estate in the UHF and higher frequency bands) also goes back to the 1970s. However, the DTV bug eventually bit, with Andrews making his initial move about five years ago.

Jim Andrews, KH6HTV

FIRST STEPS IN THE REAL OF ZEROS AND ONES TV

"I'd always had an interest in TV," Andrews said. "And as the whole industry was transitioning to digital [back in the 1990s], I knew that amateurs needed to keep up with what was going on.

His first move was to evaluate the least complicated path to DTV.

"I consider myself an analog engineer with a microwave background and knew there was no way I was going to design my own circuits to do the digital processing. So I became an 'appliance operator' [in ham jargon, someone who elects to purchase ready-made equipment, rather than fabricate their own]. I decided to identify available digital [modulation] equipment and then add RF amplification of my own design to get on the air."

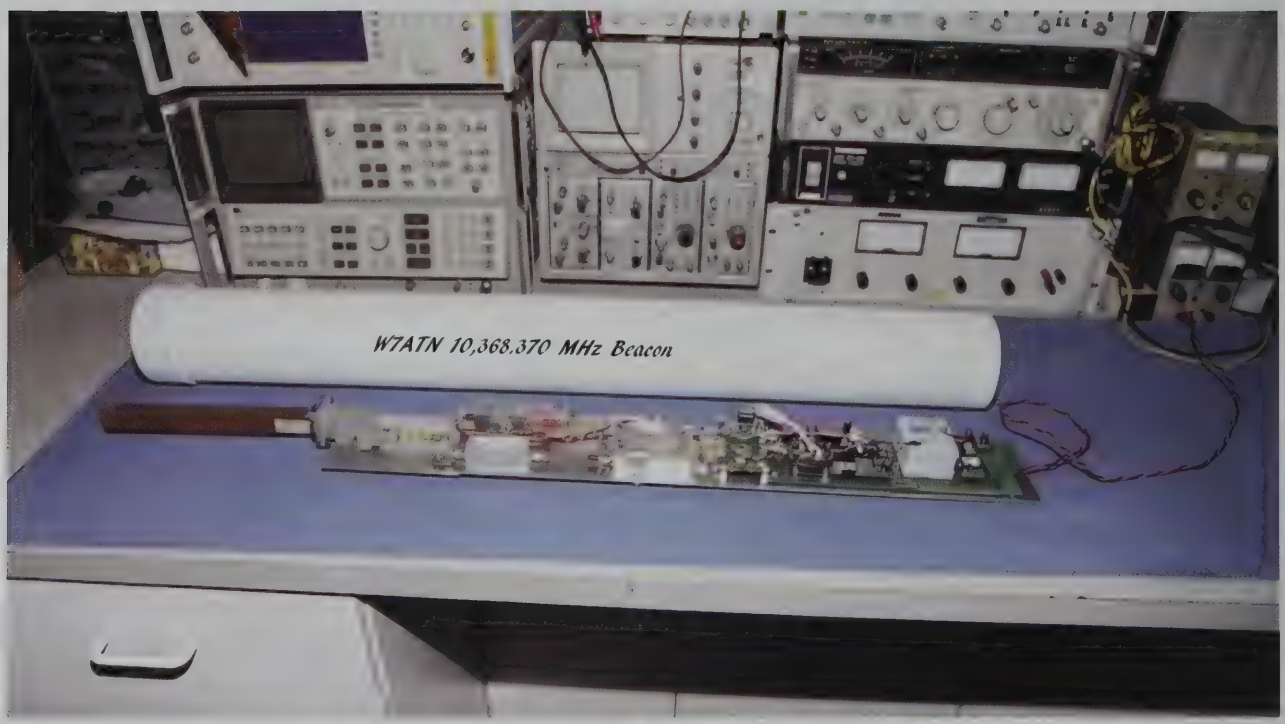
Initially Andrews investigated the commercial ATSC encoding gear that U.S. television stations were installing, but quickly experienced sticker shock.

"All I found was the really expensive stuff made by Harris and others," Andrews said. "They were all way too expensive. I was really frustrated by the prices; I wanted something down in the $1,000 price range. In 2011, I discovered a digital modulator made by Drake, a company that supplies equipment for cable system head-ends. This was the DFE 24 which sold for about $1,200. It provided 64-QAM and wasn't intended for over-the-air, but I decided to try it. I soon discovered that QAM didn't really work well with multipath as it was intended for a really perfect transmission path. There was no correction circuitry to accommodate a poor transmission channel."

Despite this limitation, Andrews took to the air on the amateur 70 centimeter band (420 to 450 MHz) by adding a 10 Watt RF amplifier of his own design and an antenna that provided an EIRP of

W7ATN adds a 10 GHz Beacon

-Kevin Jacobson AD7OI



This past January 30th, the Amateur Television Network of Arizona added a 10 GHz Beacon to our White Tanks Mountain Site at DM33RN about 30 miles North West of downtown Phoenix. The elevation of the Beacon is almost exactly 4000 Feet, which is nearly 3000 feet above most of the surrounding Phoenix Valley floor. The beacon is constructed to fit the inside dimension of a 4" PVC pipe which serves as a radome to the beacon.

The bacon is presently putting out only 300 mW into a 10 dBi Omni Slotted Waveguide antenna, is transmitting on 10,368.370 MHz, and is using a high stability 10 MHz Double Oven Temperature Controlled Crystal Oscillator to discipline a Valon Technology 5008 Frequency Synthesizer. The Beacon IDS "de W7ATN/B W7ATN/B DM33RN DM33RN sk" and then 30 seconds of carrier after which it drops for 1 second and starts over.

The beacon was previously installed on White Tanks for a short term location suitability test during the 10 GHz and up contest in August 2015, and at the time had a 2W output. This proved to be too much for use in Phoenix or any location within 100 miles line of site.

Kevin AD7OI installing the beacon

Zoomed in view of the Phoenix Valley from White Tank Mountain
Photos thanks to Tammy Jacobson

The idea of having the beacon at 10 GHz is to have something to point at accurately from other mountain tops during contesting and for tuning up 10 GHz radios and antennas.

This really works better if the source is weak and distant from the radio being tuned. Even with the beacon at only 300 mW I can pick it up on three different headings from my home QTH just over 25 miles from the site.

Two of these are bounce paths and one is a direct path but is knife edge over a mountain ridge. The beacon is in fact loud enough for my 10 GHz contest radio to pick it up in my house with the radio on the bench and with only an open waveguide for an antenna!

I don't even have line of site to the Beacon from my home, so it is likely a knife edge over the 100 foot ridge about a half mile from my home.

Now it's time to see how long the beacon stays in operation. The White Tanks site is relatively close to Phoenix at 25 miles line of site, but is about a 50 mile one way drive to the mountain top from my home. In addition, the road is 8 miles of 4WD rocky mountain roads.

73, Kevin AD7OI

Improvements to the DARA ATV Repeater

-Dave Pelaez. AH2AR

From the ATCO Newsletter: The exciter/amplifier cabinet for the 23cm FM ATV system has had a heart transplant. In the Plessey exciter's place is the Comtech 23 cm transmitter board.

This cabinet is now installed in the DARA ATV repeater rack and is working extremely well... Video looks excellent and everything is now stable. FM output is 50 watts.

The top photo is a peek inside the cabinet before I removed the Plessey PCB.

The bottom photo shows how much more room in the exciter chassis there is, with the Comtech PCB installed. Thought you would be interested in seeing the "new" equipment before it was placed back in operation.

I had to pad it down 14 dB so the Comtech board would not overdrive the intermediate amplifier.

Cheers,

Dave Pelaez. AH2AR

The Perfect Solution for an Amateur High-Definition, Digital TV station for less than $1,000 !

The Hi-Des model HV-100EH, DVB-T Modulator and the KH6HTV Video model 70-7B, 3 Watt, 70cm, Linear RF Power Amplifier. Use an inexpensive camcorder and/or Blu-Ray DVD player for your hi-definition video source. For details, see the June, 2015 issue of QST, "DVB-T: A Solution for ARES Televison Operations", pp. 42-44.

KH6HTV Video is a supplier of amateur TV equipment for the 70cm, 33cm and 23cm bands. Products include analog TV transmitters, linear RF power amplifiers (up to 25 Watts), preamp, up & down converters, FM-TV receiver and band-pass filters. For detailed spec. sheets, price list and TV Application Notes see: www.kh6htv.com Maui, Hawaii & Boulder, Colorado, USA

ATV at Quartzite Electronics & Amateur Radio Day 2016

-Gordon West WB6NOA

For many years I have been part of the organizing committee of Quartzfest, a one week long ARRL Ham Radio camp out style convention. This year Dave Anderson K1AN, the Quartzite convention organizer contacted me about putting together a La Paz County electronics and ham radio event as part of his "My La Paz Project" for the school kids, I said yes. A little background about this event as explained by Dave.

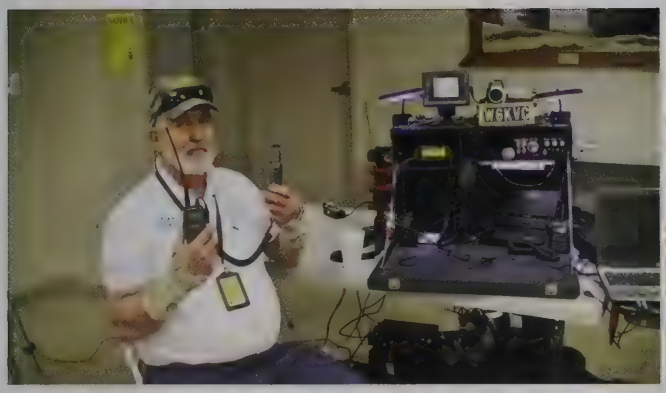
Quartzite Arizona and other small rural communities make up La Paz County, our towns are far between with income levels that are low and youth do not have much in the way of opportunities outside of school. Many students do not have smart phones, computers or internet service.

As amateur radio operators most of us know that ham radio and science have a special way of inspiring and lifting youth up into learning and possible careers in science, technology and engineering. Gordon and the rest of the Quartzfest planning committee jumped at the chance to start planning for this one day event for the kids.

We worked for months with the teachers, principals and school officials to provide this educational activity for the kids. The end result... on January 13th the week prior to Quartzfest six schools from six regional towns transported their students and some teachers and parents in three shifts to the Quartzite Community Center for a very special day to engage in 20 hands on exhibits at eight different work stations.

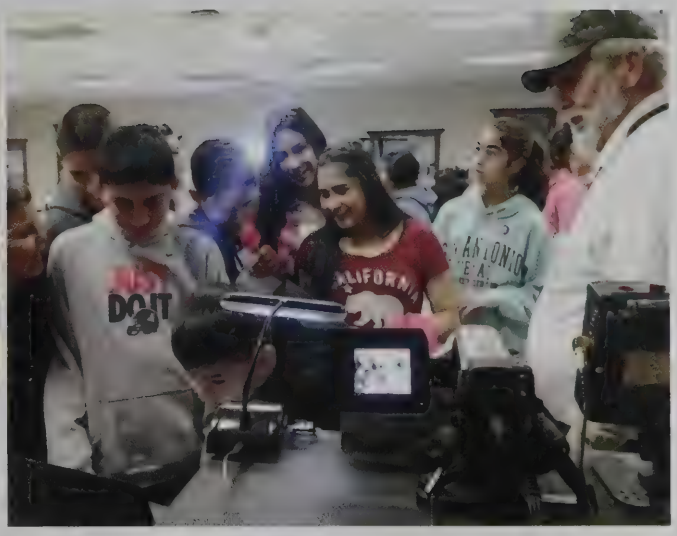
The result was a remarkable experience for 250 youth and our volunteer instructors. As a result we have six newly - licensed young hams and scheduled testing for 15 more. Each station was set up to demonstrate the different modes of communications.

Quotes from Gordo;
"The ATV and SSTV mode station was manned by Gary Heston W6KVC with Gordon West WB6NOA at the other end of the path showing the kids ATV on an Icom R3 handheld receiver. Gary is a born educator, and had the kids captivated with live ATV on the big screen".



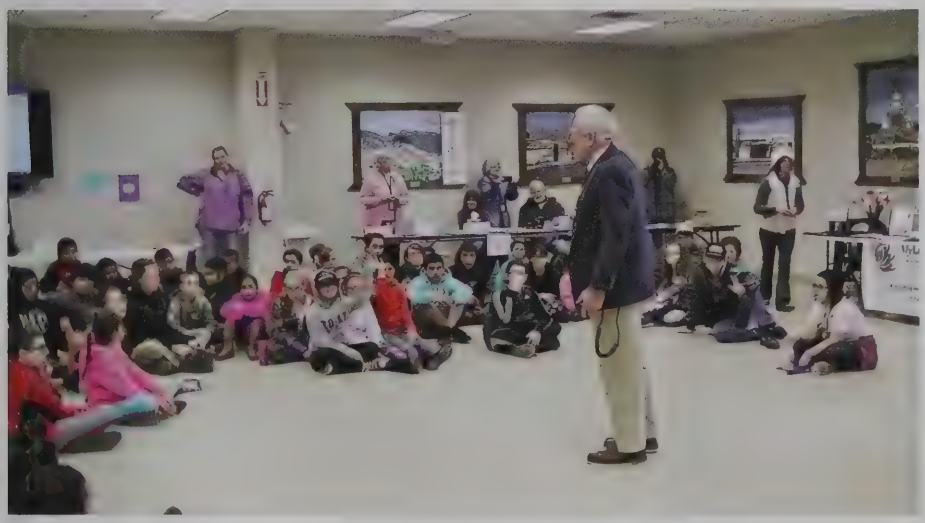
Gary W6KVC at the ATV / SSTV Station

"Gary added a 10 db attenuator to his transmitter so the ATV receivers nearby would not overload. The pictures were perfect, and the kids went wild with antics, watching themselves on the screens."
"Gary explains the benefits of ham ATV, when cell coverage goes out in the remote areas of the desert. The kids were captivated with how ATV can factor in for emergency responders to actually see a hams's reception of ATV from a distant disaster scene".



"Gary then explained how SSTV and cell phone image transfers could take place, using some of the same technology!"

"Four separate waves of students filled the day, and many came back for a second look at Gary's portable ATV/SSTV and 10 GHz equipment, live, and in action!



Kids are our future in ham radio - and cell coverage in some of the desert regions where they live, ham radio was a big hit, on the big screen, thanks to ATN support, and Gary doing an extra week out on the desert floor!"

Many thanks to our ham radio volunteer instructors and Gary and Heather for providing the photos.

Then it was on to the International Space Station, with Gary explaining how easy it is to see Slow Scan, with a simple HT tied into a computer or smart phone SSTV app.

The students had never seen a slow scan Kenwood video camera and LCD read out, and were taught to watch the SSTV captured image slowly scan down the screen!

Event Organizers:

Heather Caton	W8GEM
Gordon West	WB6NOA
Tracy Lenocker	WA6ERA
Neil Heys	W6FOG
Dave Anderson	K1AN

73, Gordo WB6NOA

Harlan Technologies

Name Tags by Gene

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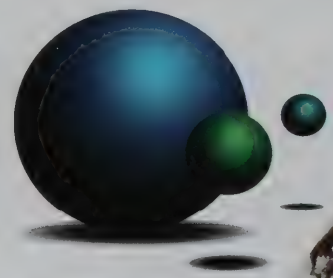

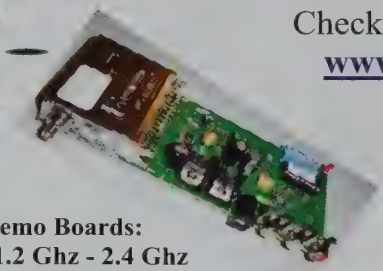

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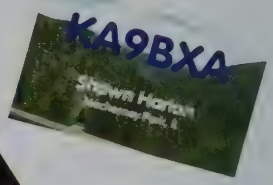

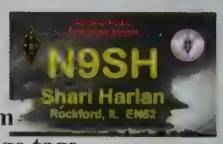

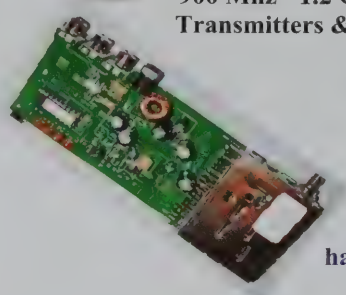

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Grand Rapids, Michigan ATV Repeater Improvements and New Location

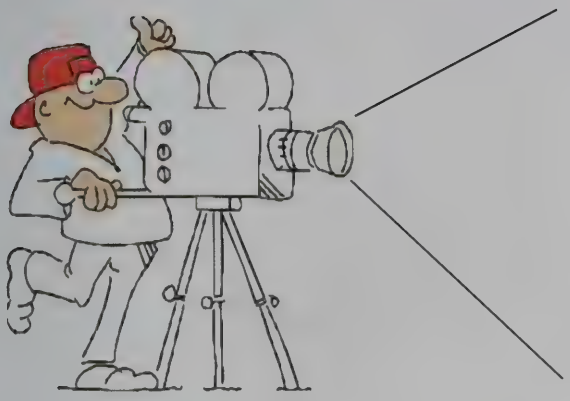
-Ron Fredricks K8DMR

From the ATCO Newsletter: Ron K8DMR has been busy improving the antenna system of the ATV repeater by relocating it to a Verizon Cell tower. Not sure how they got the site owner to let them locate there but I'm glad they did. I believe it's at the 150 foot high location and by the looks of it, it's got a clear view of the horizon.

Rib Cage Antennas

They have a rib cage antenna for transmit, another for receive with a third as a spare. He now says, "Now to get everything back on the air at the repeater site"

Ron K8DMR



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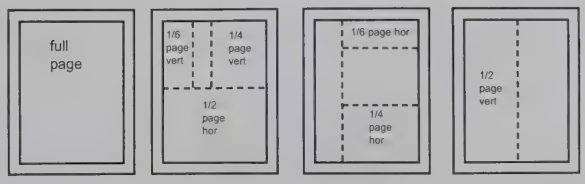

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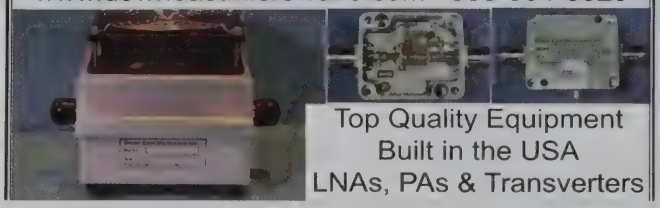

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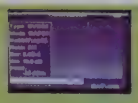

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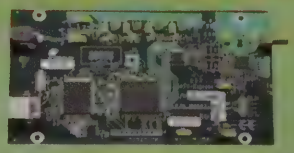

- A more affordable DATV exciter can now be ordered
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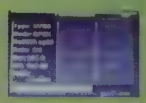
- Requires PC running Ubuntu linux (see User Guide)
- Price is US$300 + shipping – order using PayPal

For more details and ordering
www.DATV-Express.com
register on the web site
to be able to see
the PURCHASE page



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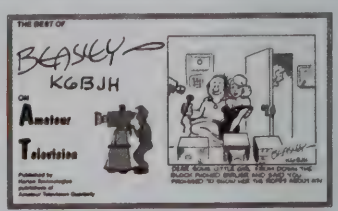

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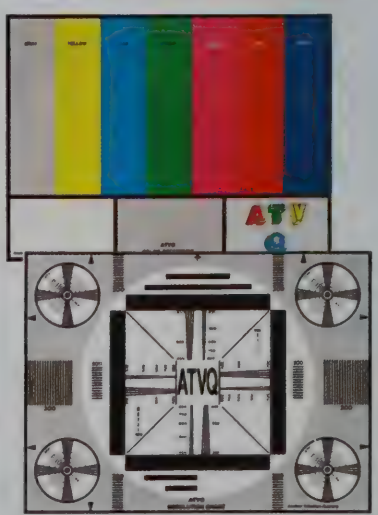

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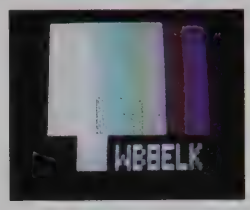

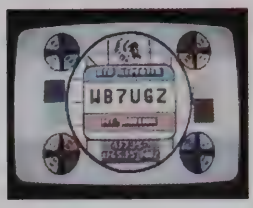

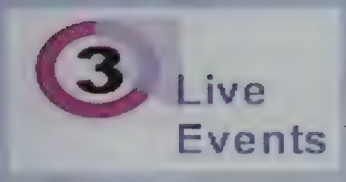

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DVB-T Experimenting in Arizona

-Jim Barbre KB7YSY

Jim Barbre, KB7YSY, of Picture Rocks, and Peter Petrotta, KD7OIW, of Glendale, have been experimenting with Digital Amateur Television (DATV) here in southern Arizona. Jim and Peter are both members of ATN, the Amateur Television Network club. Jim's interest in DATV piqued after reading an article in the June 2015 issue of QST by Jim Andrews, KH6HTV, regarding DATV activity in the Boulder, Colorado area. Jim and Peter are experimenting with a 2 MHz-wide signal using the DVB-T protocol. DVB-T stands for Digital Video Broadcasting-Terrestrial and is the DTV method used by commercial over-the-air TV broadcasters in Europe, Australia and many other parts of the world. DVB-T is superior in many ways to the ATSC standard used in the U.S., including its ability to deal with multipath.

The 2 MHz-wide DVB-T signal offers a 3 dB increase in signal strength over a 6 MHz-wide DVB-T signal, in addition to occupying one-third the bandwidth. A digital TV signal is all-or-nothing. Only 2 dB separates a perfect picture from no picture at all. The upside is, if you have a picture, you have a great one. A 2 MHz-wide DVB-T signal is 480p or SD, versus a 1080p or full HD signal that you would get with a 6 MHz-wide DVB-T signal. For most all amateur TV purposes, a 480p signal is more-than-adequate. Jim and Peter are currently experimenting with 2 MHz-wide DVB-T signals centered on 434 and 922 MHz.

HiDes, a company out of Taiwan, produces equipment for generating and receiving DVB-T pictures and sound. The UT-100D is a receive-only dongle, capable of receiving 2 MHz-wide DVB-T signals from 50-950 MHz and costing about $84. The UT-100C is a transmit-only dongle costing around $169. UT-100B is a transceiver dongle costing about $230. All of these dongles require the use of a laptop or desktop computer, connected to its USB port. HiDes also makes stand-alone exciters and receivers. They cost a few dollars more, but operate independent of a computer. The HiDes transmitters put out a signal that is 0 dBm or 1 mW -not very strong.

To operate over-the-air, a linear amplifier is needed. In order to generate a clean signal, an amplifier of high-linearity is required. Two sources of such amplifiers are KH6HTV Video and OE7DBH (in Austria). Output from DATV amplifiers is measured in average power, as opposed to peak envelope power. Thus, an amplifier capable of producing a 10W pep output will produce about a 3W digital output. Don't be fooled by the lower number. The 3W output exists across the entire 2 MHz signal, whereas the 10W output exists as a peak. If you look at the digital output on a signal generator, you will see a plateau spread across the width of the entire signal.

ATN currently operates analog ATV repeaters atop Mt. Lemmon and White Tank (NW of Phoenix). Both repeaters have analog inputs at 434 MHz. It is not-too-difficult a task to enable these repeaters to accept either a 2 MHz-wide digital input or the current analog one.

Jim's location in Picture Rocks presents a challenge. Mt. Lemmon is blocked by both the Tucson Mountains and Pusch Ridge. While Jim is able to work the 448.4 FM repeater atop White Tank, it is 118 miles from his QTH and would require more ERP than he has available to access with a DATV signal. Jim and Peter are currently working on ways to get Jim's signal (and those of other hams who may have similar constraints) into the ATV repeater system, either by finding someone on the ground to relay his signal or by establishing a new ATV site, perhaps atop another mountain.

References:

Jim Barbre kb7ysy@amsat.org

HiDes
http://www.hides.com.tw/product_cg74469_eng.html

Jim Andrews http://kh6htv.com/
OE7DBH http://dl1mfk.de/Sonstiges/Darko/

73, Jim Barbre
KB7YSY

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Article submissions can be sent to:

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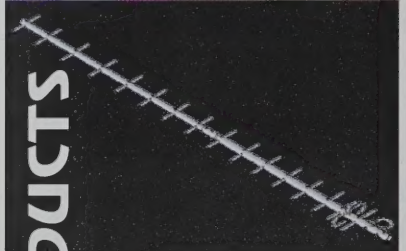

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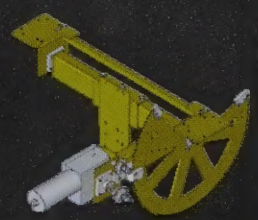

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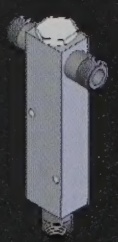

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Payment for Technical Articles

ATVQ will pay for certain articles that it publishes. I will outline the policy here, but it will be subject to change as needed to make sure that ATVQ continues to be an ongoing publication. ATVQ will pay $25.00 for technical articles that are published and are a minimum of 2 pages. While this is not a great amount, I hope it will encourage more technical type articles to be written. Exceptions will be articles that are written by a manufacturer/seller of equipment that is being written about. While I do not want to discourage this type of article, the article itself is an advertisement of the product. Articles from clubs will be encouraged, and I would expect they would like to share their information with the ATVQ readership. Information gathered from the Internet will not be paid for and is mostly small filler items.

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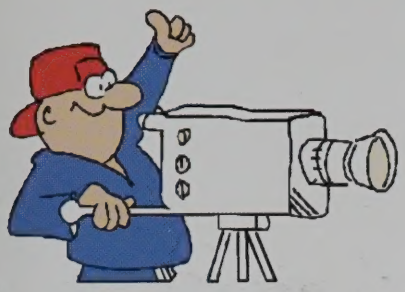
ATCO NEWSLETTER

ATV In **C**entral **O**hio is an ATV club in Columbus and our repeater WR8ATV was the first in the USA to add DATV. The club newsletter is sent not only to the local area but to several ATVers across the country. Check out our website www.atco.tv



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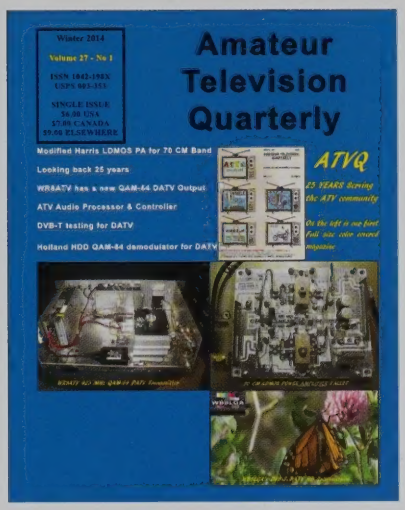
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